



RESEARCH

Renovation Needs of the US Fire Service

**Matthew Foley
July 2019**

Abstract

This report evaluates the renovation needs of the US fire stations through the review of case studies and research involving fire station renovation projects.

Note: All monetary values stated in this report are valid based on the publication year of this report.

Keywords: fire station, needs assessment, renovation.

To learn more about research at NFPA visit www.nfpa.org/research.

NFPA Index No. 2915

Copyright© 2019, National Fire Protection Association, Quincy, MA

This custom analysis is prepared by and copyright is held by the National Fire Protection Association. Notwithstanding the custom nature of this analysis, the NFPA retains all rights to utilize all or any part of this analysis, including any information, text, charts, tables or diagrams developed or produced as part hereof in any manner whatsoever as it deems appropriate, including but not limited to the further commercial dissemination hereof by any means or media to any party. Purchaser is hereby licensed to reproduce this material for his or her own use and benefit, and to display this in his/her printed material, publications, articles or website. Except as specifically set out in the initial request, purchaser may not assign, transfer or grant any rights to use this material to any third parties without permission of NFPA.

Key Findings

The renovation needs of the US Fire Stations evaluated in this report are summarized below:

- **Fire Stations over 40-Years Old** – The Fourth Needs Assessment of the US Fire Service reports that 21,230 fire stations, or 43 percent of all US fire stations, are over 40-years old. These stations are more likely to have problems that cannot be addressed through repair and maintenance alone. Roughly 61% of the fire stations with this deficiency exist in communities serving less than 9,999 people. The Craftsman National Building Cost Manual provides construction estimates for a new fire station based on the size and quality of the facility. Additionally, a case study of the Houston Fire Department describes the replacement of a 54-year old fire station with a new 10,800 square-foot fire station for \$5.1 million. Based on the assumptions in this report, the total cost to replace the 21,320 fire stations over 40-years old is estimated between \$70 billion to \$100 billion.
- **Fire Stations without Exhaust Emission Control** – The Fourth Needs Assessment of the US Fire Service reports that 29,120 fire stations, or 59 percent of all US fire stations, do not have exhaust emission control. These systems mitigate firefighter exposure to diesel fumes when an apparatus leaves or returns to the station. Roughly 78% of the fire stations with this deficiency exist in communities serving less than 9,999 people. A local tailpipe system, which filters both particulates and gases, can be installed for roughly \$40,000 to \$60,000 per fire station. Based on the assumptions in this report, the total cost to renovate the 29,120 fire stations without exhaust emission control is estimated between \$1.2 billion to \$1.7 billion.
- **Fire Stations without Backup Power** – The Fourth Needs Assessment of the US Fire Service reports that 17,030 fire stations, or 35 percent of all US fire stations, do not have access to backup power. Access to a backup power supply is critical to ensuring that fire departments can continue operations during an emergency event. Roughly 75% of the fire stations with this deficiency exist in communities serving less than 9,999 people. FEMA provides the Hazard Mitigation Grant Program to assist with these expenses and assumes a project cost of \$50,000 to install a generator for a fire station serving 27,000 residents. Two generator installations completed with the Hazard Mitigation Grant Program report a project cost of roughly \$88,000 to \$100,000 per fire station. Based on the assumptions in this report, the total cost to provide the 17,030 fire stations without backup power with an emergency generator is estimated between \$850 million to \$1.7 billion.
- **Fire Stations without Separate Facilities for Female Firefighters** – Since many of the 40-year-old fire stations were constructed when fire departments were exclusively male, a sizable portion of these stations was likely built without consideration for female firefighters. Although the US Department of Labor reported that only 5.9 percent of career firefighters were women in 2015, the Fourth Needs Assessment estimates that roughly 10 percent of all firefighters, including career and volunteer representatives, were women during this year. It is also important to note that the distribution of male and female representation in the fire service varies between different types of fire departments and the size of the community they serve. The costs to install separate facilities for female firefighters are dependent on the scope of work required for each fire station. Tampa Fire Rescue has previously addressed this issue by installing sleep partitions in 17 fire stations for \$160,000 while FDNY has opted to completely renovate 47 of these fire stations for a reported estimate of \$50 million. It is recommended that

further research is conducted to determine the total number of fire stations that do not provide separate facilities for female firefighters in order to estimate the total cost to renovate these stations.

- **Fire Stations in Need of Mold Remediation** – Despite the industry perception that mold in fire stations is a common concern, the total number of fire stations affected by this issue is unknown. When the Nashville Fire Department tested all of their fire stations in 2011, it identified mold in 33 of the 37 stations. Regardless of any existing mold, the International Association of Fire Fighters recommends that all fire stations include humidity control, adequate ventilation and the use of mold inhibiting products. If mold remediation is necessary, the costs for removal are dependent on the extent of mold growth. While the Conroe Fire Station mold remediation project cost roughly \$90,000, the South Portland Fire Department required major renovations with a project estimate of \$1.3 million. It is recommended that further research is conducted to determine the total number of fire stations affected by the presence of mold to estimate the total remediation cost for these stations.

1. Introduction

To estimate the demands of the fire service, NFPA publishes a study called the Needs Assessment of the US Fire Service. The Fourth Needs Assessment was published in 2016 with the findings of its 2015 study. This assessment followed three earlier surveys completed in 2001, 2005 and 2010. The goal of the survey is to compare what fire departments actually have with what existing standards, government regulations, and other guidance documents state they need in order to be safe and effective (Haynes).

The purpose of this report is to evaluate the renovation needs of US Fire Stations and evaluate several solutions for each deficiency. Case studies are included throughout this report to provide real-world examples and to help estimate the costs associated with each remediation project. The deficiencies noted in this report include fire stations that: (1) are over 40-years old, (2) are not equipped with exhaust emission control, (3) are without backup power, (4) do not have separate facilities for female firefighters, and (5) are in need of mold remediation.

2. Renovation Needs

2.1 Fire Stations over 40-Years Old

2.1.1 The Problem

Although there is no national guidance for the maximum age of a fire station, it is assumed that more problems will be present in older fire stations. These fire stations are more likely to have problems that are unable to be addressed through repair and maintenance alone. To evaluate this concern, NFPA uses 40-years old as a threshold to identify aging fire stations (Haynes).

The Fourth Needs Assessment reports that approximately 61% of the fire stations greater than 40-years old exist in communities serving less than 9,999 people. The total number of fire stations over 40-years old in communities of certain population size are estimated in Table 1 (Haynes).

Population of Community	Number of Fire Stations
500,000 or more	1,340
250,000 to 499,999	480
100,000 to 249,999	930
50,000 to 99,999	890
25,000 to 49,999	1,460
10,000 to 24,999	3,200
5,000 to 9,999	2,440
2,500 to 4,999	2,860
Under 2,500	7,630
Total	21,230
Percent of US Total	43%

A shortage of funding, including tight budgets and an absence of grants to support the construction of new fire stations, could explain the high percentage of older stations. Overall, the percentage of fire stations over 40-years old has increased since 2001. This progression is illustrated in Figure 1 (Haynes).

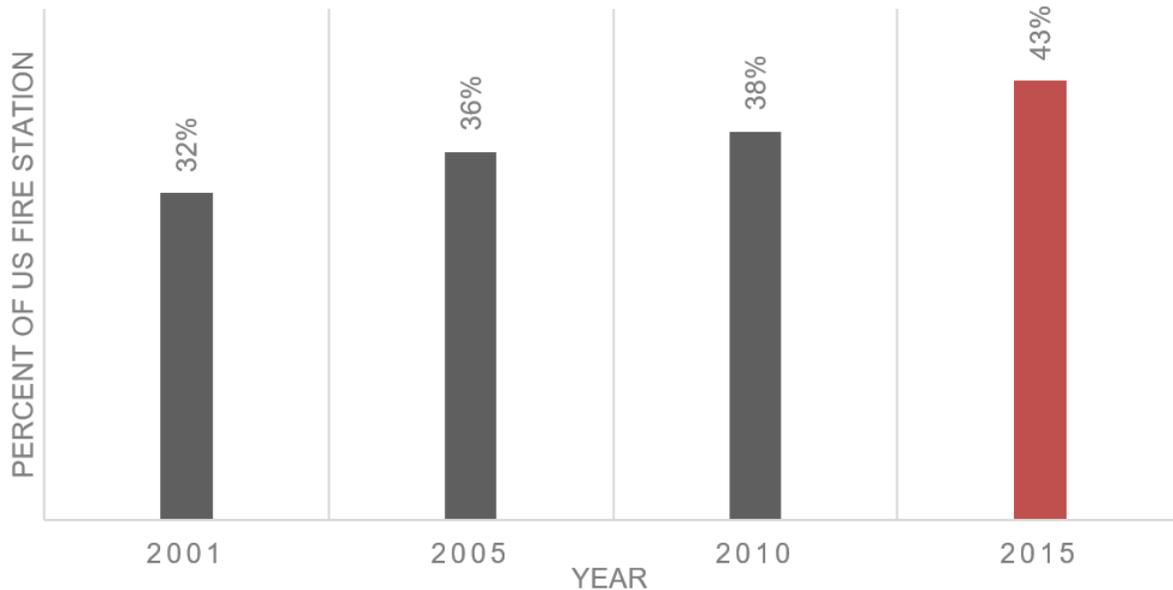


Figure 1: Percentage of Fire Stations over 40-Years Old

Since the percentage of fire stations over 40-years old is steadily increasing, it is likely that the percentage of older stations is also increasing. Therefore, many of the fire stations that were recorded as 40-years old in 2001 were likely over 55-years old when the Fourth Needs Assessment was published in 2016 (Haynes).

2.1.2 The Cost

To estimate the costs of new construction, Craftsman produces a National Building Cost Manual. The National Building Cost Manual includes tools to estimate the project costs of a new fire station. However, these estimates only represent the construction costs including labor, material, equipment, plans, building permits, supervision, overhead, and profit. The construction cost estimates for a new fire station are listed in Table 2 (Moselle).

Table 2: Construction Cost Estimates for a New Fire Station			
First Floor – Estimated Cost per Square Foot			
<i>Quality Class</i>	<i>6,000 SF</i>	<i>10,000 SF</i>	<i>20,000 SF</i>
<i>Best</i>	\$241	\$225	\$209
<i>Average</i>	\$156	\$146	\$135
<i>Low</i>	\$116	\$108	\$101
Second and Higher Floors – Estimated Cost per Square Foot			
<i>Quality Class</i>	<i>6,000 SF</i>	<i>10,000 SF</i>	<i>20,000 SF</i>
<i>Best</i>	\$212	\$197	\$184
<i>Average</i>	\$137	\$128	\$119
<i>Low</i>	\$102	\$95	\$89

In addition to the basic construction costs of a fire station, total project costs include land acquisition, financing, and professional service fees paid to the architect and subcontractors. It is also important to consider that labor costs will be more expensive where the project is constructed with state or federal funds as this financing typically requires the payment of prevailing wages (Wilmoth).

To minimize the costs of a new fire station, Brown Reynolds Watford Architects recommends the following considerations (Wilmoth):

- **Building Shape** – The design of the building can be rectangular to minimize construction costs.
- **Construction Type** – Wood construction can be used for the living side of the fire station to reduce costs. Additionally, the bays can be concrete masonry units which can serve as durable exterior material.
- **Site Plan** – Site paving is a sizable expense that should be minimized where possible.

One option to reduce costs is to use a prefabricated wood building in the construction of a new fire station. These prefabricated buildings can drastically reduce construction costs to roughly \$60 to \$70 per square foot. Another option to minimize construction costs is to utilize town resources. For example, the Richmond Fire Department saved on the cost of their new fire station by performing demolition with road crews. Some cities may even be willing to waive fees or install meters and taps for the project at a reduced cost (Wilmoth).

While several economical options are available, some jurisdictions may decide to use the funding towards the construction of a more advanced fire station. In 2009, the Houston Fire Department began a project to replace a 54-year old fire station. This development involved the construction of a one-story, 10,800 square-foot fire station consisting of three apparatus bays, a study area, an exercise room, a full kitchen, and a covered outdoor grill area. The project received a LEED-silver certification, making it the first fire station to achieve this designation in Houston. The project cost was roughly \$472 per square foot with a total cost of \$5.1 million. The new Houston Fire Station 37 is shown in Figure 2 (Houston Green Building).



Figure 2: Fire Station 37 in Houston, TX

It is difficult to determine the cost of a new fire station without knowing space needs, location, site condition and professional preferences of the fire department. Since many fire stations are constructed with a cost of \$275 to \$400 per square foot, these values can be used as a rough estimate for jurisdictions evaluating a new fire station project (Wilmoth). For example, the

construction of a new 12,000 square-foot fire station could be estimated at roughly \$3.3 million to \$4.8 million. Using these assumptions, the total cost to replace the 21,230 aging fire stations with new 12,000 square-foot fire stations can be estimated at roughly \$70 billion to \$100 billion. These cost estimates are summarized by communities of certain population size in Table 3.

Population of Community	Number of Fire Stations	Low Estimate	High Estimate
500,000 or more	1,340	\$4.4B	\$6.4B
250,000 to 499,999	480	\$1.6B	\$2.3B
100,000 to 249,999	930	\$3.1B	\$4.5B
50,000 to 99,999	890	\$2.9B	\$4.3B
25,000 to 49,999	1,460	\$4.8B	\$7.0B
10,000 to 24,999	3,200	\$10B	\$15B
5,000 to 9,999	2,440	\$8.1B	\$12B
2,500 to 4,999	2,860	\$9.4B	\$14B
Under 2,500	7,630	\$25B	\$37B
Total	21,230	\$70B	\$100B

2.2 Fire Stations without Exhaust Emission Control

2.2.1 The Problem

When a diesel-powered fire apparatus leaves or returns to a fire station, it generates hazardous emissions that can spread throughout the apparatus bay and living quarters. If the exhaust is not properly captured, firefighters can be exposed to diesel exhaust for an extended portion of their shifts (Baldwin). This deficiency can be mitigated through the installation of an exhaust emission control system.

According to the Occupational Safety and Health Administration (OSHA), prolonged diesel exhaust and diesel particulate matter exposure can increase the risk of cardiovascular disease, cardiopulmonary disease, respiratory disease and lung cancer. In 2012, the International Agency for Cancer Research classified diesel exhaust as a known human carcinogen (OSHA). The focus of the fire service on this topic is exemplified by the major initiative to establish a new NFPA standard on contamination control in the fire service and the Fire Protection Research Foundation Report titled “Recommendations for Developing and Implementing a Fire Service Contamination Control Campaign” (Stull). In today’s heightened sense of contamination control, exhaust emission control is one specific focus area.

The Fourth Needs Assessment reports that approximately 78% of the fire stations without exhaust emission control exist in communities serving less than 9,999 people. The total number of fire stations without exhaust emission control in communities of certain population size are estimated in Table 4 (Haynes).

Population of Community	Number of Fire Stations
500,000 or more	640
250,000 to 499,999	280
100,000 to 249,999	600
50,000 to 99,999	750
25,000 to 49,999	1,320
10,000 to 24,999	2,840
5,000 to 9,999	3,440
2,500 to 4,999	5,150
Under 2,500	14,100
Total	29,120
Percent of US Total	59%

Although a majority of fire stations are not equipped with exhaust emission control, there has been considerable renovation progress since 2001. The number of fire stations without exhaust emission control had declined from 78 percent in 2001 to 66 percent in 2010. From 2011 to 2014, an estimated 2 percent of the Assistance to Firefighters Grant funds were awarded to facility modification projects. This funding contributed to the reduction of fire stations without exhaust emission control from 66 percent in 2010 to 59 percent in 2015. This progression is illustrated in Figure 3 (Haynes).

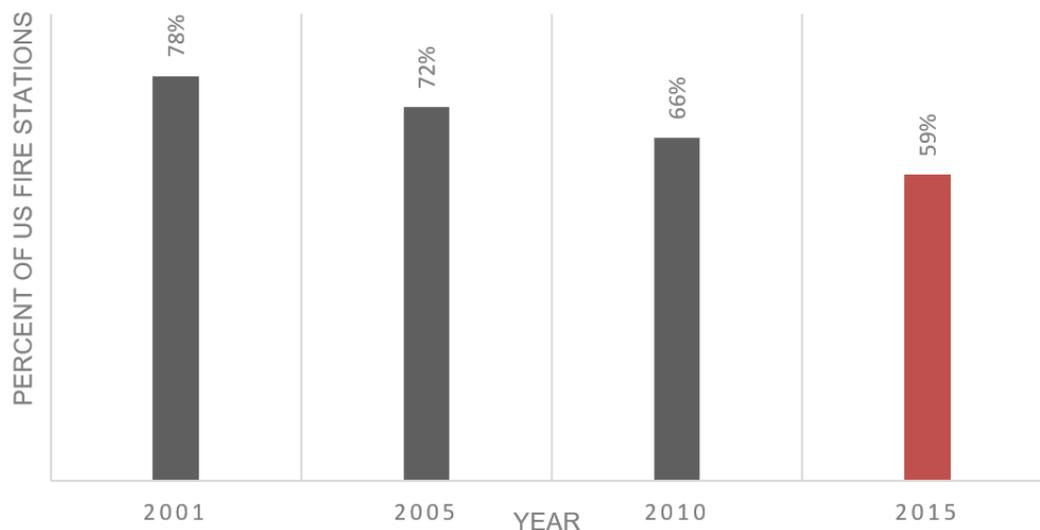


Figure 3: Percentage of Fire Stations without Emission Control

2.2.2 The Cost

There are generally three different options to capture exhaust emissions in a fire station. These options include the following (Baldwin):

- **Engine Exhaust Filters** – This method uses filters in the exhaust system or at the apparatus tailpipe to remove particulate from the exhaust stream. The main disadvantage of this method is that only particulate is removed from the exhaust stream while the gases of the exhaust are not filtered. The approximate cost of one filter system was \$10,000 in 2009.
- **Local Tailpipe Exhaust Ventilation** – This method works by attaching a hose to the apparatus tailpipe and connecting it to an exhaust fan. Since the exhaust is discharged outside of the station, this method removes particulate and gaseous emissions from the apparatus bay. The main disadvantage of this method is that firefighters must remember to attach the hose to the apparatus tailpipe. The costs of this system vary with the length of hose, type of overhead mounting and the number of options purchased. To offset the expenses of these systems, some manufacturers have teamed up with organizations to provide grant writing assistance (Plymovent). Several manufacturers also specify that these systems can be installed by firefighters to offset expenses, however, the labor concerns of some fire departments may restrict the installation of these systems to trained professionals (Air Cleaning Specialists). As a result, the costs of these systems are estimated between \$40,000 and \$60,000 (Jackson).
- **Dilution Ventilation** – This method uses a fan to exhaust the contaminated air outside while fresh makeup air flows into the garage through open doors or supply air openings. The fan can be integrated into the station alerting system to ensure that it turns on before the fire trucks are started. The main disadvantage of this method is the sizable costs of heating or cooling the makeup air. Therefore, the total cost of a dilution ventilation system is heavily influenced by the climate of the installation site.

When selecting which system is the best fit for a specific fire department, several factors should be considered including cost, local serviceability, mechanical codes, energy codes, climate, existing equipment and apparatus type (Copeland). For many fire stations without any exhaust emission control, the installation of a local tailpipe exhaust ventilation is a substantial improvement. This system is common in many fire stations since it provides adequate filtration of both particles and gases and can be installed in different climates without the high expenses of conditioning makeup air.

An example of the local tailpipe exhaust ventilation system is shown in Figure 4 (Plymovent).



Figure 4: Local Tailpipe Exhaust System Example

Assuming that a local tailpipe exhaust ventilation system is professionally installed, the average cost of each system can be estimated as roughly \$40,000 to \$60,000. Using these assumptions, the total cost to renovate the 29,120 fire stations without exhaust emission control with a local tailpipe exhaust ventilation system would be roughly \$1.2 billion to \$1.7 billion. These cost estimates are summarized by communities of certain population size in Table 5.

Population of Community	Number of Fire Stations	Low Estimate	High Estimate
500,000 or more	640	\$26M	\$38M
250,000 to 499,999	280	\$11M	\$17M
100,000 to 249,999	600	\$24M	\$36M
50,000 to 99,999	750	\$30M	\$45M
25,000 to 49,999	1,320	\$53M	\$79M
10,000 to 24,999	2,840	\$110M	\$170M
5,000 to 9,999	3,440	\$140M	\$210M
2,500 to 4,999	5,150	\$210M	\$310M
Under 2,500	14,100	\$560M	\$850M
Total	29,120	\$1.2B	\$1.7B

2.3 Fire Stations without Backup Power

2.3.1 The Problem

In an emergency event, fire stations require access to backup power to ensure that firefighting activities can continue effectively. If a fire station loses power, it may be difficult to answer phones, run computers, fuel trucks and open garage doors (Heaney). Despite this criticality, a considerable portion of fire stations in the US are not provided with emergency generators.

The Fourth Needs Assessment reports that approximately 75% of the fire stations without backup power exist in communities serving less than 9,999 people. The total number of fire stations without backup power in communities of certain population size are estimated in Table 6 (Haynes).

Population of Community	Number of Fire Stations
500,000 or more	670
250,000 to 499,999	160
100,000 to 249,999	330
50,000 to 99,999	400
25,000 to 49,999	710
10,000 to 24,999	2,070
5,000 to 9,999	1,630
2,500 to 4,999	2,530
Under 2,500	8,540
Total	17,030
Percent of US Total	35%

The percent of fire stations without backup power has declined since 2001. This progression is illustrated in Figure 5 (Haynes).

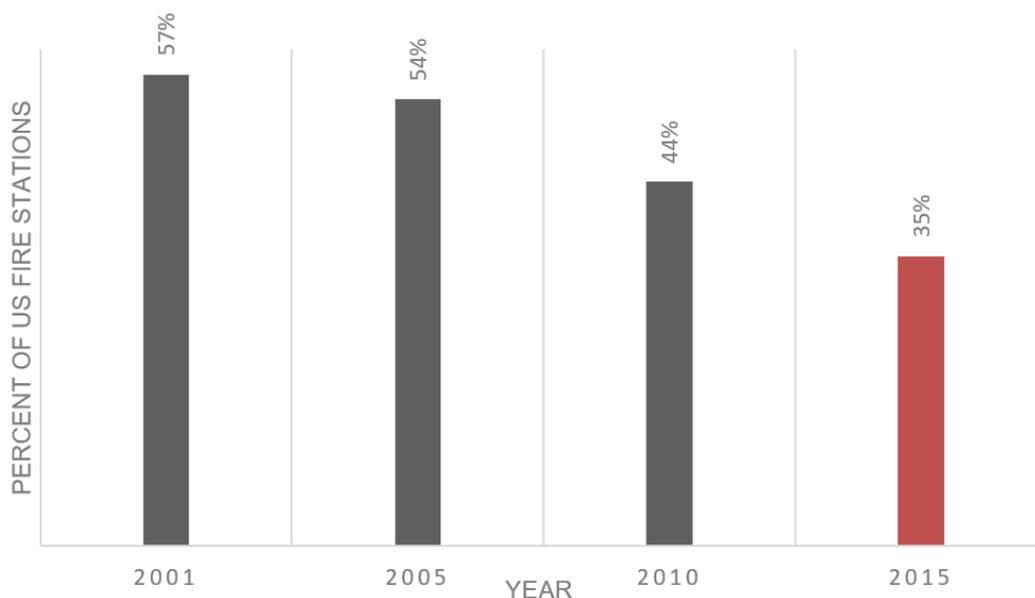


Figure 5: Percentage of Fire Stations without Backup Power

2.3.2 The Cost

When selecting a generator for a fire station, it is important to consider the following characteristics (Heaney):

- **Essential Equipment** – Fire Departments must determine which equipment is critical to maintaining effective operations. These systems typically include telecommunications, electrical outlets, lights, computers, fuel pumps, and garage door motors.
- **Generator Size** – A licensed engineer can help determine which size generator will be required based on the electrical load of the fire station.
- **Fuel Source** – Many fire departments are equipped with diesel fuel tanks for trucks which can be used to power the emergency generator. However, since fuel supply may be interrupted during the emergency event, fire stations may opt to install a natural gas generator or a bi-fuel generator that uses both diesel fuel and natural gas.

The Federal Emergency Management Agency (FEMA) provides a Hazard Mitigation Grant Program to assist with the installation of emergency generators in fire stations. In the model scenario provided by FEMA, a generator installation project costs approximately \$50,000 for a fire station serving up to 27,000 residents. This estimate assumes that the efficiency of the fire station drops to 50 percent when power is lost and the useful life for the generator is 19 years (Federal Emergency Management Agency). A Washington-based company called Resource Solutions reported success in using the FEMA Hazard Mitigation Grant Program to acquire generators for two separate fire districts. One project involved the installation of four fire station generators for roughly \$88,000 per generator while another project included the installation of five station generators for roughly \$100,000 per generator (Resource Solutions).

Based on the information provided by FEMA and Resource Solutions, a typical fire station generator installation is estimated to cost roughly \$50,000 to \$100,000. Using this assumption, the total cost to retrofit the 17,030 fire stations without backup power with an emergency

generator would be roughly \$850 million to \$1.7 billion. These cost estimates are summarized by communities of certain population size in Table 7.

Population of Community	Number of Fire Stations	Low Estimate	High Estimate
500,000 or more	670	\$34M	\$67M
250,000 to 499,999	160	\$8.0M	\$16M
100,000 to 249,999	330	\$17M	\$33M
50,000 to 99,999	400	\$20M	\$40M
25,000 to 49,999	710	\$36M	\$71M
10,000 to 24,999	2,070	\$100M	\$200M
5,000 to 9,999	1,630	\$82M	\$160M
2,500 to 4,999	2,530	\$130M	\$250M
Under 2,500	8,540	\$430M	\$850M
Total	17,030	\$850M	\$1.7B

2.4 Fire Stations without Separate Facilities for Female Firefighters

2.4.1 The Problem

As the number of female firefighters continues to increase, many fire departments are recognizing a need to retrofit fire stations to accommodate women. These renovations include the construction of separate bathroom facilities, separate shower facilities, and partitions in sleeping quarters.

The first paid female firefighter in the US did not begin her employment as a public safety officer until 1973 (Turner). This is important to consider since roughly 43 percent of all US fire stations were constructed prior to 1976, or 40-years before the Fourth Needs Assessment was published in 2016. This means that a sizable portion of the operational fire stations in the US were constructed before the first paid female firefighter was even employed. As a result, many of these older fire stations were likely constructed without consideration for female firefighters.

The progression of female representation among career firefighters, according to the US Department of Labor statistics, is illustrated in Figure 6 (NFPA).



Figure 6: Female Employment in the US Fire Service

The Fourth Needs Assessment estimates that roughly 7.1 percent of career firefighters were women in 2015. This value is slightly higher than the US Department of Labor statistics which estimates that roughly 5.9 percent of career firefighters were women in 2015 (NFPA). Since women represent roughly 14 percent of the police force and military, female representation in the fire service is considered to be low by comparison (McCoppin). However, the US Department of Labor estimation excludes the 91,150 women who served as volunteer firefighters in 2015 (Haynes). When volunteer firefighters are included in this calculation, women represented roughly 10 percent of all US firefighters in 2015 (Haynes). As a result, it is possible that female representation in the US fire service has been considerably understated in recent history.

It is also important to question if a singular statistic is an accurate characterization of female representation in the fire service since the distribution of male and female firefighters varies considerably between different types of fire departments. This is apparent in fire departments serving less than 2,500 people, where women are estimated to represent the majority of career firefighters. The percentage of female representation among career and volunteer firefighters of certain population size are summarized in Table 8 (Haynes).

Population of Community	Career	Volunteer	Total
500,000 or more	3.9%	44%	7.1%
250,000 to 499,999	4.7%	27%	7.4%
100,000 to 249,999	3.5%	58%	7.4%
50,000 to 99,999	3.9%	18%	5.9%
25,000 to 49,999	2.7%	14%	6.3%
10,000 to 24,999	3.7%	11%	8.3%
5,000 to 9,999	7.2%	8.9%	8.7%
2,500 to 4,999	19%	10%	11%
Under 2,500	52%	11%	12.8%
Total	7.1%	11%	10%

The values in Table 8 and the corresponding tables in the Fourth Needs Assessment can be used to identify which fire departments are in critical need of separate facilities for female firefighters. For example, female representation in the fire service appears to be more common in communities serving less than 9,999 people. As previously noted in this report, roughly 61% of the aging fire stations, which were likely constructed without consideration of female firefighters, exist in these types of communities. It is unknown if previous renovation efforts have addressed this pattern of varied female representation in the fire service.

2.4.2 The Cost

In 2015, Tampa Fire Rescue in Florida began a project to retrofit their fire stations with separate facilities for female firefighters. To address this need, the department installed six-foot-high privacy partitions where male and female firefighters share sleeping quarters. This project included the renovation of 17 older fire stations that were constructed when Tampa Fire Rescue was exclusively male. The reported project cost was \$160,000, or roughly \$9,400 per fire station (Tampa Tribune).

In 2015, the New York City Fire Department (FDNY) began a similar project on a larger scale. While there are more than 10,000 FDNY firefighters, only 44 are women. Despite the limited

number of female firefighters, renovations were completed to install separate locker rooms, restrooms and shower facilities in 168 of New York's fire stations. According to the FDNY Commissioner, women are not assigned to fire stations without female facilities. To complete renovations in the remaining 47 fire stations, the reported project costs are \$50 million (Chayes).

Since the total number of fire stations without separate facilities for female firefighters is unknown, the total cost to upgrade all fire stations with this deficiency is difficult to estimate. Moving forward, it is recommended that this topic is further researched to determine the magnitude of this issue and develop strategies to mitigate the deficiency.

2.5 Fire Stations in Need of Mold Remediation

2.5.1 The Problem

There is an industry perception that mold growth in fire stations is a common problem, however, the exact magnitude of this issue is unknown. Mold has the potential to cause reactions similar to seasonal allergies for some people including nasal stuffiness, eye irritation, and sneezing. Exposure to very high levels of mold can cause hypersensitivity pneumonitis which has symptoms similar to pneumonia (International Association of Fire Fighters).

Indoor mold growth usually indicates water damage, prolonged humidity, or dampness (International Association of Fire Fighters). For these reasons, mold growth in fire stations is a typical concern. For example, the Nashville Fire Department tested all of its fire stations in 2011 after a firefighter was diagnosed with respiratory issues relating to mold. The inspectors discovered mold in 33 of the 37 fire stations tested during the assessment (Firehouse).

In all fire stations, funding should be allocated to mold prevention. To prevent mold growth in fire stations, the following characteristics should be considered (International Association of Fire Fighters):

- **Humidity** – Humidity levels should be minimized through the use of an air conditioner or dehumidifier.
- **Ventilation** – Adequate ventilation should be provided through the installation of exhaust fans.
- **Mold Inhibitors** – Mold inhibitors should be added to paint before application inside of the fire station.
- **Cleaning Products** – Bathrooms and other areas susceptible to mold growth should be cleaned regularly with mold killing products.

2.5.2 The Cost

If mold is discovered in a fire station it should be removed. The cost of mold remediation is dependent on the amount of mold spread throughout the fire station. Large-scale mold remediation, including mold growth in multiple rooms or the HVAC system, should be performed by an experienced professional. As a result, the costs to remediate mold growth in a fire station can vary substantially (International Association of Fire Fighters).

In 2017, the Conroe Fire Station in Texas approved a \$90,000 project to remove mold caused by heavy condensation from an air-conditioning unit. Since the fire station was constructed in

2011, this example demonstrates the potential for mold growth even in newer facilities (Dominguez).

Another fire department that recently completed a mold remediation project is the Cash Corner Fire Station in South Portland, Maine. In 2018, the Cash Corner Fire Station planned a project to remove mold throughout the ceiling, insulation, and walls of the facility with an estimated construction cost of \$1.3 million. The South Portland Fire Chief described the building as a “mold incubator” due to a design that made the building airtight. Mold remediation of this scale reportedly involved stripping the building to its frame and rebuilding (Laaka).

There has been limited research quantifying the magnitude of this problem. Moving forward, it is recommended that further research is conducted to determine how many fire stations are in need of mold remediation. This research can be used to evaluate the severity of the issue and estimate the total cost to remediate all fire stations affected.

3. Conclusion

Although the conditions within US fire stations are continuing to improve, there are still many issues that need a resolution. While previous studies have estimated the magnitude of the deficiencies noted in this report, the costs of renovation efforts are ultimately dependent on the severity of each issue within the individual fire stations. Moving forward, it is critical that the progress of these renovations is recorded and shared with the fire service and policymakers. For this reason, the NFPA Needs Assessment of the US Fire Service is a critical tool to ensure that the safety for firefighters continues to improve nationwide.

4. References

- Air Cleaning Specialists. *Fire Station Exhaust Removal*. 2019.
- Baldwin, Tommy. "Controlling Diesel Exhaust Exposure Inside Fire Houses." *Fire Engineering Magazine* (2011): 1-11.
- Chayes, Matthew. "FDNY to spend \$50 million for women's facilities at 47 firehouses." *Newsday* (2015).
- Copeland, Michelle. "Confronting Fire Department Diesel Exhaust Exposure Concerns - Part 5: Maximizing Your Resources." *Firehouse* (2018).
- Dominguez, Catherine. "Mold in Conroe fire station will cost \$90K to remediate." *Chron* (2017).
- Federal Emergency Management Agency. "Eligibility of Generators as a Fundable Project by the Hazard Mitigation Grant Program and Pre-Disaster Mitigation Program." 2015.
- Firehouse. "Mold found in 33 Fire Stations in Nashville." *WSMV.com* (2011).
- Haynes, Hylton. *Fourth Needs Assessment of the U.S. Fire Service*. Quincy: NFPA, 2016.
- Heaney, J. "Emergency Generators – Will Your Fire Company be Able to Respond this Winter?" *Walden Environmental Engineering* (2014).
- Houston Green Building. *Firestation 37 Houston Fire Department*. 2009. March 2019.
- International Association of Fire Fighters. "Mold in the fire station." 2017.
- Jackson, Marjorie. "Escalon Fire Receives Grant For New Exhaust System." *Escalon Fire* (2005).
- Laaka, Juliette. "South Portland fire station mold could cost city \$1.3M." *The Forecaster* (2018).
- McCoppin, Robert. "As Joliet hires 1st female firefighter, women still fight for equality: 'We're assumed incompetent'." *Chicago Tribune* (2018).
- Moselle, Ben. *2017 National Building Cost Manual*. Manual. Carlsbad: Craftsman Book Company, 2017.
- NFPA. *Firefighting occupations by women and race*. Quincy: NFPA, 2016.
- OSHA. "Diesel Exhaust/Diesel Particulate Matter." *United States Department of Labor* (n.d.).
- Plymovent. "Plymovent Makes Getting a Grant Easier." *Firehouse* (2015).
- Resource Solutions. *FEMA Hazard Mitigation Grants*. Leavenworth, n.d.
- Stull, Jeff. "Recommendations for Developing and Implementing a Fire Service Contaminataion Control Campaign." *Fire Protection Research Foundation* (2018).
- Tampa Tribune. "Fire dept. adds partitions for female firefighters' privacy." *Fire Chief* (2015).
- Turner, Pat. *Stair Steps to Your Firefighter Badge: Mastering the Realm of Entry-Level Testing*. Fulton Books, 2016.
- Wilmoth, Janet. "Why Do Fire Stations Cost So Much?" *Firehouse* (2017).